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CORRELATION OF SPACECRAFT PASSIVE MICROWAVE SYSTEM DATA WITH SOIL MOISTURE INDICES (API)

By

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Progress Report for Period
August 1978 - February 1979

TEXAS A&M UNIVERSITY
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1.0 INTRODUCTION

This study is directed toward testing and improving correlations between passive microwave antenna temperatures from space and indices of soil moisture over a large area in the southern Great Plains. McFarland (1977) correlated digital data from the Electrically Scanning Microwave Radiometer (ESMR) to an antecedent precipitation index that in turn is correlated to soil moisture over the northwestern third of Oklahoma. The ESMR wavelength (1.55 cm) is not optimum for sensing soil moisture; however, encouraging results were obtained for a minimum vegetation three month period in the Fall of 1973.

The cloudless atmosphere is not completely transparent to the ESMR frequency (19.35 GHz) which is close to the water vapor resonant frequency of 22.235 GHz. Because of their attenuation and scattering properties clouds and precipitation may also effectively mask surface emmissions at the EMSR frequency. Surface microwave emmission is affected by roughness, vegetation, and soil moisture. Emmission attributed to soil moisture can be dominated by the vegetation and roughness parameters especially for short wavelengths. Longer wavelengths on future sensors, such as the Scanning Multifrequency Microwave Radiometer (SMMR) could bypass these limitations and provide an adequate system for large area crop monitoring and antecedent watershed conditions for improved flood prediction.

2.0 PROJECT DESCRIPTION

A large region of the southern Great Plains is being used as a basis for calibration of passive microwave systems as an estimator of antecedent precipitation which in turn is related to soil moisture (Fig. 1). This region was selected for two reasons: first, it encompasses the area used by McFarland (1977) in the preliminary study of ESMR data, and, secondly, the area is a principle source of hard winter wheat. Daily values of precipitation and air temperatures and all available ESMR brightness temperatures over this region will be related to a 25 x 25 km grid. These values will then be used to model emmissivity and API in such a way as to optimize their correlation. The block of grid points used by McFarland and shown in Fig. 2 will be used to establish a relationship between effective microwave emmissivity and API. The relationship will then be used to predict ESMR antenna temperatures for another large wheat producing area in Kansas using API as an input. Comparison of predicted and actual antenna temperatures in such a relatively independent area should provide verification of the techniques. Simultaneously time series estimation of API values on independent cells will be studied to determine if it is feasible to use ESMR data to monitor drought conditions in the southern Great Plains.
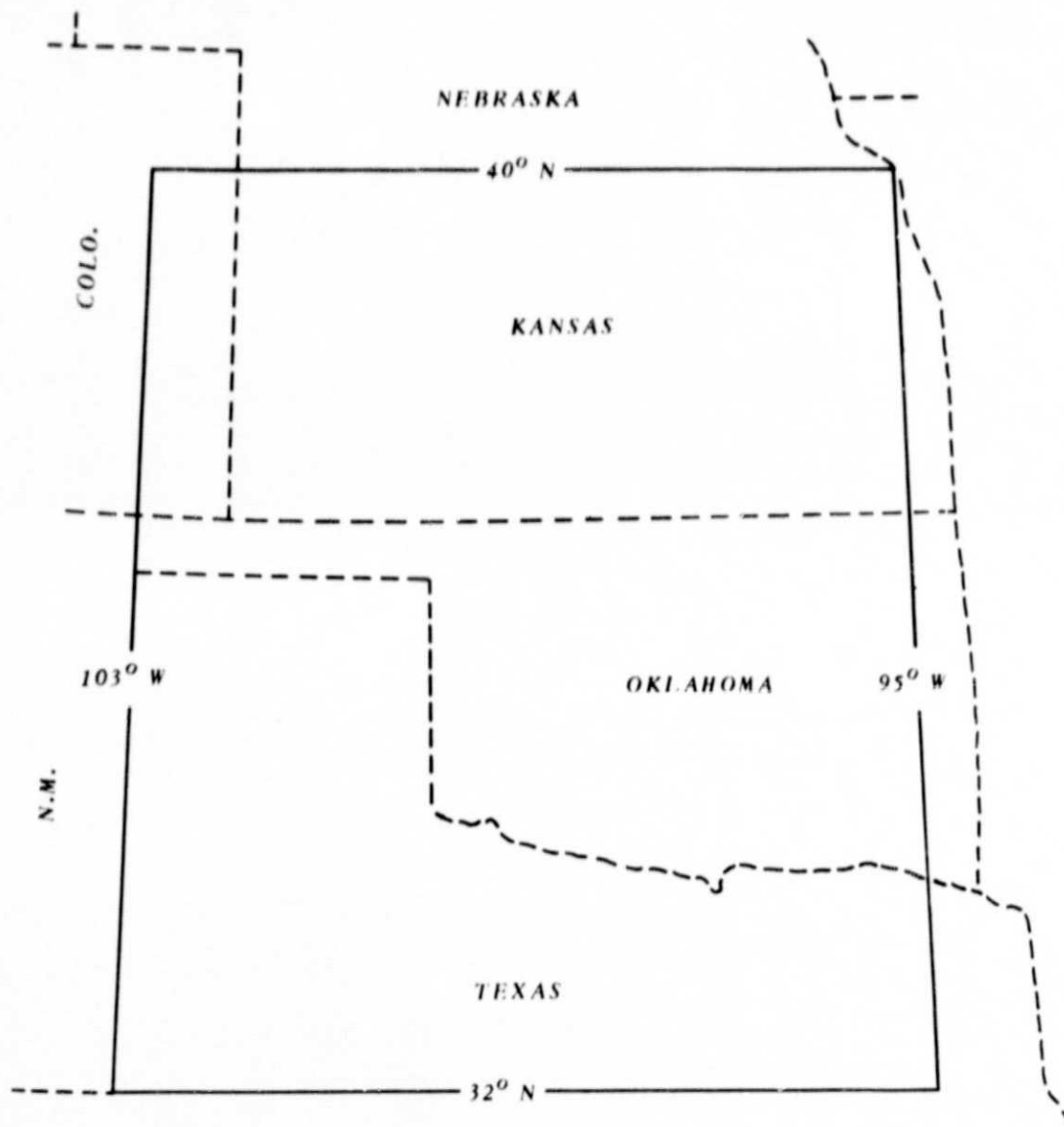
NEBRASKA

40° N

COLO.

KANSAS

103° W

OKLAHOMA

95° W

N.M.

TEXAS

32° N

FIGURE 1: Southern Great Plains Area To Be Used

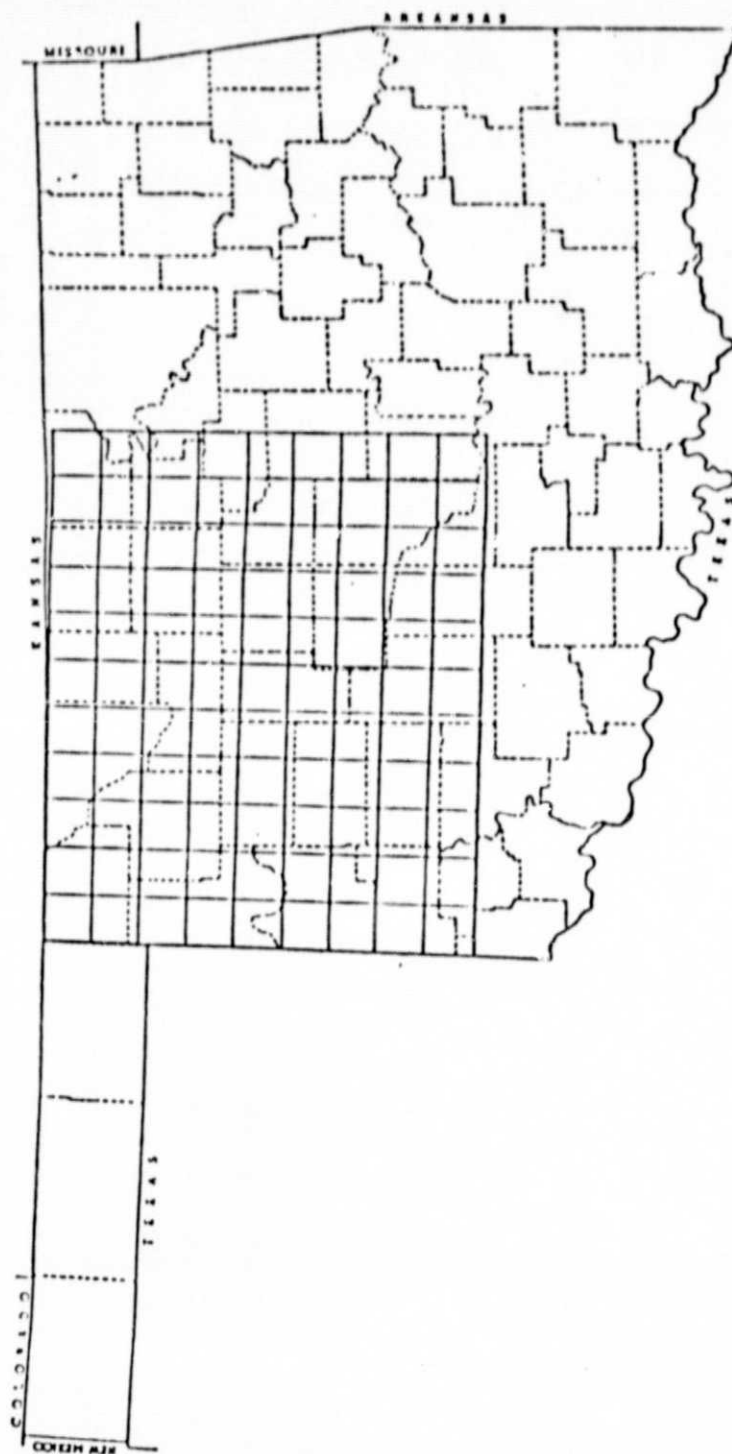As A Basis For Calibration Of ESMR

FIGURE 2: Gridded Area Used By McFarland In Preliminary Study

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3.0 PRESENT STATUS OF CONTRACT REQUIREMENTS

ESMR antenna temperatures with appropriate locations for each datum point have been received for the southern Great Plains. The time frame of this data is Sept 1973 through May 1975 with a large gap in the data during the summer of 1974. This gap and another two years of data have been requested. SMMR data will be requested for the same region upon its availability. Daily precipitation and temperature data tapes have been received for the region for 1973 through 1976. These data and the ESMR data has been reduced and placed on a direct access disk to facilitate future processing.

Data for the preliminary study area in the northwestern third of Oklahoma has been relaxed to correspond to the 25 x 25 km grid of McFarland. Computing techniques and data have been verified by reproducing McFarland's results. Work is presently being undertaken to extend McFarland's techniques to other seasons of the year when the vegetation is significant and its influence on the ESMR data may be dominant over surface moisture.

Soil moisture and precipitation data from the Chickasha-USDA Agriculture Research Station is also being analyzed to determine the correlation of API to actual soil moisture. These data do not correspond to the period of the ESMR data but will be used in the modeling of soil moisture from API. A separate report on the results of this portion of the study

is being prepared for publication and will be submitted to the contract monitor on completion .

The project supervisor has placed an order for the purchase of an $800 computer terminal in order to facilitate the large amount of data processing incurred by this study. Bids have been received and the terminal is on order.

Progress to this data has been satisfactory and is on schedule with the work plan. No problems are anticipated in the completion or the remaining work on the ESMR data.

SMMR data will be requested after data algorithms have been verified for the system. Hopefully a full season of data can be collected over this study area by this system to determine whether the longer wavelengths will improve estimates of antecedent precipitation indices.

4.0 REFERENCES

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